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Encapsulation and release behaviour of hydrophilic and lipophilic model compounds on lactoferrin-glycomacropetide nanohydrogels

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Abstract

Protein-based nanohydrogels have attracted great attention due their non-toxicity, small dimension and large interior network for multivalent bioconjugation, offering several possibilities for the encapsulation of functional compounds. The aim of this work was to evaluate the capacity of protein nanohydrogels to encapsulate two different bioactive model compounds and evaluate their release behaviour under different conditions. Lactoferrin (Lf) and glycomacropetide (GMP) are two natural proteins with isoelectric points of 8.5 and 4.8, respectively. Lf and GMP solutions were mixed at pH 5.5, and then subsequently stirred with a specific bioactive compound concentration and heated at 80 °C, during 20 min for the formation of the nanohydrogels. Two bioactive compounds, curcumin and caffeine have been used as lipophilic and hydrophilic compound model, respectively and were encapsulated into nanydrogels. The resulting nanohydrogels with loaded bioactive compounds were then characterized in terms of morphology, encapsulation capacity and release behaviour. Results showed that nanohydrogels presents a curcumin and caffeine binding capacity of 95.12 % and 90 %, respectively. Bioactive compounds release from nanohydrogels was evaluated by the experimental data of the release kinetics of bioactive compounds under different conditions (i.e. pH 2 and 7). Mathematical models were fitted to the experimental data using non-linear regression. Results showed that transport of bioactive compounds from nanohydrogels followed a Linear Superimposition Model which accounts for both Fickian transport behaviour and polymer relaxation. Depending on the nature of bioactive compound it was observed different release behaviours: lipophilic compound was not released at pH 7, contrarily to hydrophilic compound. At low pH (pH 2) it was observed that the transport mechanism of bioactive compounds from nanohydrogels was driven by the concentration gradient and due the matrix reconfiguration due to contact with a liquid medium. Results showed that is possible to encapsulate two different bioactive compounds in protein nanohydrogels, envisaging great possibilities for food and pharmaceutical applications.

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